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SOME REMARKS ON TRANSPLANTATION OF THE CORNEA AND ALLIED SUBJECTS.

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Corneal opacity is the opprobrium of ophthalmic surgery. Almost every other diseased tissue has yielded at least partial success to the advance of modern eye surgery. Destroyed eyelids are restored by plastic operations, occluded pupils are re-opened, opaque lenses are removed, foreign bodies are discovered and often removed by the electro-magnet. Glaucoma is transferred from the list of incurable to curable diseases. Amaurosis has become almost an obsolete word in ophthalmological literature. But the irremediably blind from corneal opacity remain so still, and surgeons can offer these unfortunates no more hopeful prognosis than the poor one given by some such operation as Darwin suggested in 1801 who asks, "Could not a piece of the cornea be cut out by a kind of *trephine* about the size of a thick bristle, or a small crow quill, and would it not heal with a transparent scar?" "An experiment," he adds, "I wish strongly to recommend to some ingenious surgeon or oculist."[1]

This experiment has been tried by many ingenious surgeons and oculists with such uniformly discouraging results that it seems like almost a useless waste of time to call attention to the subject again, and I should not do so if it were not, that the newspapers have given the subject so much notoriety, and have created

[1]Zoonoma, Ed. 1801, Vol III, p. 71.

the false hope in the minds of many incurably blind people that they may have useful vision again. Even a few medical journals have been beguiled into publishing glowing accounts of cases of successful transplantation of the cornea, so that it is not surprising that the general practitioner, who has given the history of the subject but little attention, may have been misled as to the results of the operation, and not infrequently sends patients to the specialist with a promise of relief which cannot be afforded, and as a result, the reputation of both the general practitioner and the oculist must suffer.

It was the classic Mead who, in his chapter on albugo, recommended the use of equal parts of powdered glass and sugar candy levigated to an impalpable powder. "A little put into the eye every day," he says, "gradually absterges and wears off the spot by its inciting quality."

This, I imagine, was somewhat more effectual than the modern molasses treatment recommended by a countryman. Another method very highly recommended by this author is to order a dexterous surgeon to pare it cautiously every day with a knife. He adds, with amusing *sang froid:* "The paring of the cornea has not succeeded above once or twice with me."[1]

Sclerectomy is the name applied to the attempt which has been made to form an artificial pupil by the removal of a small portion of the sclerotic and choroid in cases in which the whole cornea is opaque, in the hopes that the space might be filled up by a transparent membrane. This opening for a time does certainly permit of a shadowy outline of near objects, but the opening soon contracts and becomes closed with a dense cicatrix, so that practically it has proved of no benefit.[2]

Martin, in a recent number of the *London Medical Record,*

[1]Medical Works of Richard Mead, M. D., Edinburg, 1775. P. 410.

[2]Those interested in this subject can refer to the following works: Schmid, de Pupilla artificiali in Scleroctica aperienda; Tubingae, 1814. Ammon, in Zeitschrift für die Ophthalmologie, Vol. I., p. 109; Dresden, 1831. Wutzer, Ibid, P. 486. Villnan in Ibid, P. 123, Vol. II, Dresden, 1832. Nimmo in Glasgow Medical Journal for April, 1833. William Mackenzie, Disease of the Eye, Third Edition, London, 1840, P. 760. Antwerth Tübingen, Blätter für Naturwissenschaft, Vol. I, P. 88.

proposes division of one rectus and the advancement of the opposite so as to rotate the globe about 45°. A gold canula is then inserted into the sclerotic, and the conjunctiva united over it until inflammation has subsided, when the conjunctiva over the canula is destroyed by cauterization, and a glass stopper inserted to allow the entrance of light. Comment seems scarcely necessary, but the absurdity of the suggestion only forces the unwelcome truth the more upon us, viz., that all of these operations devised up to the present time have proved impracticable and unsatisfactory.

Akin to sclerectomy and the insertion of a gold canula is the proposition of Dr. Nussbaum, first made in 1853, to make an opening through the opaque cornea and to insert a small piece of glass shaped like a shirt-stud, with the hopes that it will be permanently worn there without inconvenience and will act as a substitute for the transparent cornea.[1]

Heusser records one case in which the glass button remained in the cornea and permitted useful vision for three months after its introduction.[2]

In this connection a report of the following case, from my own practice, which has not been hitherto published may be of interest.

Mr. Hull, a druggist of Cleveland, æt. 35, on July 4, 1885, was charging a soda fountain when it exploded, filling his eyes with acid which resulted in sloughing of the entire cornea and the lids of both eyes. A dense cicatrix with no lids nor any corneal tissue proper was formed, holding the eyeballs almost immovable. Notwithstanding this condition the tension remained about normal, the perception of light was good and so far as I could judge there was no intra-ocular inflammation or degeneration.

I decided to insert a glass button in one eye. This I did in July, 1886. When the bandages were removed, the button

[1]Zeitschrift für Wissenshaftliche Zoologie; Vol. V., P. 179, 1853.

[2]Aerztl. Intelligenzblatt, 1860, No. 24. Stellwag on the Eye; fourth revised edition, Wm. Wood & Co. 1873. P. 113.

was retained in situ very firmly. The perception of light was, however, almost abolished.

This, as the ophthalmoscopic examination revealed, was due to a large clot of blood, covering the back portion of the button. This clot gradually became absorbed, the perception of light slowly returned, and at the end of three months the patient could see the outline of large objects, count fingers, and distinguish colors. But in the course of a few months the eye began to grow soft, there was a slight oozing of a sticky substance around the button for a time, although it remained in the eye without causing any particular trouble for almost two years, and probably could have been retained longer, but the sight gradually became less, and at the end of a year and a half, he was practically blind.

At the present time, about two years and a half after the operation, the eyeball is soft and shrunken, and much smaller than the other, although the tension has become very much reduced and the perception of light has disappeared from the unoperated eye also.

The results of this operation led me to believe that: 1st. A glass button may be worn for an indefinite period. 2nd. That in order to make this possible, it may be well to limit the movements of the eye, by inducing an adhesion between the lids and eyeball. 3rd. That the improvement of vision will only be temporary as the constant irritation by the foreign body will sooner or later cause a disorganization of the eye. 4th. It will be necessary if the lense has not escaped from the eye to first remove it. 5th. It will also be as well to remove as much as possible of the iris, since its contact with the glass button would be undesirable. I offer these suggestions for what they are worth, and I would be pleased to hear from any one who has made experiments in this direction.

This brings us to the consideration of the subject proper, Corneal Transplantation.

Reisinger, of Augsburg, in 1818, first proposed this operation, and published results of experiments on animals in 1824, which were quite "promising." Dieffenbach in 1831 repeated

these experiments a number of times without success.

In 1839 the Medical Faculty of Munich offered a prize for the best work on the subject of Corneal Transplantation, but it led to no practical results.

Prof. Wutzer, of Bonn, in 1844, made use of the cornea of a live sheep, which he transplanted to that of a human cornea. Union took place but in a few weeks it became quite opaque. He repeated the experiments with no better results.[1]

About the same time Hurley and Thorne, of Bonn, made quite a number of satisfactory experiments in the same direction.

In the *Gazette des Hopitaux* for Aug., 1845, Dr. Plouviez states that during five or six years he had performed the operation a great many times. Yet, he had not been able to secure permanent transparency in a single instance.

Among the cases reported was that of a woman 23 years old who was blinded when three years old by small pox, in which, after separating the opaque cornea, he applied on the stump, and secured by four sutures, the cornea of a young dog that had just been killed.

The grafting succeeded perfectly, but the results were not satisfactory; the only benefit resulting from the operation was that the woman could distinguish day from night better than formerly.

M. Faldman[2] reported the results of twenty experiments made at the suggestion of Walther, of Munich, and comes to the conclusion, that the transparency of the cornea which subsists for a few days after the operation, disappears afterwards.

Dr. Kissman reports a case in which the cornea of a pig was transplanted to that of an Irishman. The cornea continued transparent for a fortnight, when it became opaque, and in the course of a month it was absorbed.

We might cite numerous other cases from the literature of ophthalmology of forty or fifty years ago, in which the results

[1]New York Medical Journal for March, 1844.

[2]In Vol. 42 of the Edinburgh Medical Journal, page 256.

of transplantations are detailed, showing that surgeons then met with the same flattering results for the first few days or weeks, only to find the cornea become opaque, and the patient no better after, possibly no worse, than before the operation.

Among the more recent contributions to this subject is that of Mr. Henry Powers,[1] of London. His operation consists in removing a portion of the opaque cornea of the patient with a sharp punch, specially devised for the purpose, and obtaining by the same measure an exactly corresponding portion of a healthy rabbit's cornea, and transferring it to the space in the human eye.

In one case he reports he found the union complete, and the results "promising."

Dürr[2] made a number of experiments in transplanting pieces of the cornea from 5 to 8 mm. long, by 5 to 6 mm. broad, and 1 m. in thickness, covered with epithelium. The freshened surface was somewhat smaller, a narrow slip of sclerotic tissue was removed, with the cornea, together with a portion of the conjunctiva which served as a flap to be secured by sutures.

Among others he reports the case of a boy in a blind-asylum, whose one eye was shrunken while there was dense leucoma of the cornea of the other. The transplanted cornea adhered in two days. During the first few days it was cloudy, but gradually it became clear, so that at the end of two months the transplanted piece resembled an island of clear cornea, and the boy was enabled to see large objects, and find his way about. This operation like the more recent one of Von Hippel presupposes that Descemet's membrane is transparent, which is not the case of the vast majority of cases, and necessarily makes the field of this operation a limited one. Mr. Wolfe,[3] of Glasgow, Scotland, has, however, perfected the operation of transplanting the entire thickness of the human cornea from

[1]Medical Times and Gazette, Aug. 10, 1872.

[2]Klinische Monatsbl. f. Augenheilkunde, Sept., 1877.

[3]Wolfe on Disease of the Eye.

one eye to another, and has reported some excellent results. In one of his cases good union took place, and on the fourteenth day after the operation the patient could see sufficiently to point out a ring on the finger. Before dismissal from the hospital he could distinguish between a half sovereign and a shilling. After dismissal he was exposed to severe cold and privation, and the new cornea became opaque. His operation consists in transplanting a long narrow piece from the entire breadth of the cornea which is connected with a conjunctiva flap at either end. The clear cornea is retained in its new position by means of sutures through the conjunctival flaps.

Sellerboeck[1] has operated upon a number of cases in a similar manner, with temporary improvement of vision and promising results.

One disadvantage of this operation is that it requires a human cornea which is often difficult to obtain; or at least the cornea of some animal whose cornea is of the same size, similar thickness and curvature.

De Wecker[2] uses a small trephine with which he removes a small circular piece of cicatricial cornea to be replaced by a similar piece of clear cornea from another eye which has been recently enucleated. He says, "We have no right in these cases to refuse the slightest aid to sufferers who have but this one remaining chance to recover a little sight; neither should we be deterred by the reproach of eccentricity which will certainly be leveled at any one who shall attempt to graft a cornea."

Von Hippel, in 1885, succeeded in giving a patient (who could see only to count fingers at a distance of six feet before the operation) vision of $^{20}/_{CC}$, and since then he has reported another case in which there has been considerable increase of vision.

Leber demonstrated that any breach of continuity of Des-

[1]Archiv f. Ophthalmologie, xxx.

[2]Ocular Therapeutics 1879. Page 145.

cemet's membrane is followed by discouraging action of the aqueous upon the overlying parenchyma of the cornea. Von Hippel acting upon this suggestion removed a button of the opaque cornea leaving Descemet's membrane intact, and with the same trephine a button from the whole thickness of a rabbit's cornea is excised, and laid in the wound. In his operation he uses a trephine very similar to a Hœurteloup's leech, and the piece is taken from the centre of the leucomatous cornea and so as not to include the entire thickness of the cornea.

It will be seen that the field for this operation must be a very limited one, as it presupposes that Descemet's membrane is transparent.

In such a case it may be a question whether the same results might not have been gained by irritants, or by simple incisions and friction, or, possibly, by the heroic use of jequirity. May not the improvement of visual acuity have been due to the inflammation induced by the presence of a foreign body rather than to the clearness of the transplanted cornea?

Adamük[1] has also made some interesting observations in this direction. He considers the preservation of Descemet's membrane of much less importance than the preservation of some portion of the neighboring sclerotic, whence the cornea draws its nourishment. Of five cases in which the trial was made on fowls' eyes, suppuration took place in two, the transparency of the cornea was preserved in three cases, but we are not told with what visual results.

Adamük's operation is similar to Dürr's, excepting that he transplants the entire thickness of the cornea.

Fox[2] has reported glowing accounts of brilliant results secured in two cases operated upon by the Von Hippel method. The results as reported later by the newspapers have evidently not been so favorable. In one case we are told the cornea

[1]Klinische Monatsblätter, 1887.

[2]Philadelphia Press, Cincinnati Enquirer and other daily papers.

sloughed, and in the other a suit has been commenced for damages.

Chisolm[1] has reported a case in which he secured union of the transplanted cornea by the Von Hippel method, but the cornea remained opaque.

My personal experience in this operation has been confined to a few operations of transplanting, by Wolfe's method, the cornea of one rabbit to that of another.

When the operation was done carefully, in about one-half the cases the cornea would unite and remain clear from one to two weeks, after which it would gradually become opaque; the eye usually became soft, and *phthisis bulbi* was the result. These experiments were, however, performed under such circumstances as to have but little scientific value. Yet the results were so discouraging as to deter me from attempting the operation on the human eye until some more promising results will have been attained by those who are in a position to make the experiment under more favorable surroundings.

It may be assumed from our present experience with this operation that:

1. The cornea when transplanted, either by the methods of Dürr, Wolfe or Von Hippel, will become adherent.

2. That by any of these methods the graft will remain clear for a short time, but eventually become opaqe in the vast majority of cases. Frequently the eye becomes soft and *phthisis bulbi* will result.

3. There is some common cause for failure either inherent in the eye operated upon, the grafts themselves, or the method of operation. This is a matter that will demand the attention of all in future experiments and operations made in this direction.[2]

4. Glowing newspaper reports of successful corneal transplantation should be taken *cum grano salis.*

5. Other methods of treating corneal opacities should be

[1]Maryland Med. Journal, June 30, 1888.

[2]Johnson, British Medical Journal, Dec. 16, 1886. P. 1209.

re-investigated, especially the scraping of opacities and daily friction as recommended by Dr. Danziger, and the central cauterization of the cornea by the galvano-cautery loop, as recommended by M. Louis Vacher, also the pricking of the cornea, galvanism, subconjunctival injections, all of which have proved beneficial in the hands of many operators. This may even prove a more fruitful field for investigation and experiment than corneal transplantation.

THE VALUE OF CREOLIN IN OPHTHALMIC PRACTICE.

BY ADOLF ALT, M. D.

Ever, since the enthusiastic article by Purtscher in *Hirschberg's Centralblatt* drew my attention to the new disinfectant, creolin, I have used it almost daily. My experience with this remedy is such that I do not hesitate to draw the attention of my *confrères* to it.

Originally creolin was manufactured by the firm of W. Pearson & Co. in Hamburg, Germany, and they described it as being a dry destillate from English coal. The controversy as to its real nature, which has gone through the journals, does not concern us here. The trustworthy firm of Merck, of Darmstadt, now manufactures it also. It is a thick, oily, dark brown fluid with a peculiar smell, reminding one of tar, carbolic acid and the smell around gas-factories. When mixed with water it makes a milky solution (probably emulsion). After such a solution has stood for several days, it changes its milk-color and assumes a brownish tint; at the same time small brown globules become separated from the rest of the solution and sink to the bottom of the bottle. It is, therefore, probably best to make only a small quantity of such a solution and to renew it every two or three days. I have used it in a 1% and 2% solution. In this strength, instilled into the conjunctival sac, it causes a very severe pain followed by profuse lachrymation. This pain lasts about a minute and then disappears. The previous instillation of a cocaine solution does not seem to have any effect on this pain.

I have tried its application by instillation in all forms of external eye-affections, in order to see whether it would really prove superior to other known remedies, especially the bichloride of mercury. Its action surely equals that of bi-chlo-

ride of mercury in catarrhal conjunctivitis, blepharitis ciliaris, in corneal ulcers, and in lachrymal troubles. In phlyctænular keratitis it acts more beneficially than sublimate. Its most beneficial action, however, creolin exerts on parenchymatous keratitis, whether syphilitic or scrofulous. I have seen corneæ clear up in an astonishingly short time under its application, which appeared to have remained unchanged and uninfluenced by any other of the usual methods of treatment. In trachoma, for which it has been highly praised by some authors, I have not been able to see any benefit from its use. In fact, in the few cases I tried it, it seemed to aggravate the process in such a manner as to make me afraid to use it again.

Creolin is also very useful as a hæmostatic. After lid-operations and enucleations I have repeatedly, in a very short time, staunched what was an excessive hæmorrhage, by the use of creolin.

Since first experimenting with creolin I have discarded all other methods for disinfecting the instruments used in an operation. They are always put into a 2% solution of creolin, and from it I take them during the progress of the operation as I need them. Aside from its perfectly satisfactory action in rendering the instruments aseptic, it is superior to sublimate, boracic acid, etc., by in no way influencing the sharpness of the instruments. I also wash my hands in it before every operation, and wash the conjunctival sac with it. I further prefer it when bandaging eyes operated upon to sublimate for moistening the cotton.

Aside from the pain which it causes when instilled into the conjunctival sac, I have found nothing disagreeable in its use.

Several times after prolonged contact with it in operations lasting from half an hour to an hour, I tasted it for hours. Unpleasant as it was, this absorption of creolin had no other, especially no poisonous, effect upon me, as far as I know.

From the foregoing experiences I can very well add my testimony to that of Purtscher, and recommend the application of creolin especially in *parenchymatous keratitis*. I, furth-

ermore, can recommond it strongly as a disinfectant for surgical instruments and as a hæmostatic.

Incidentally, I may mention here that it has also under my observation acted very well in old cases of purulent otitis media.

PARTS OF THE INTRODUCTION TO A DISCUSSION ON THE TREATMENT OF SENILE CATARACT.

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In the Section of Ophthalmology at the Annual Meeting of the British Medical Association, held in Glasgow.

* * * With these preliminary observations, I pass on to the main subject which we have in hand; and I fear it must be conceded that the "treatment" of senile cataract must be limited to the methods by which it can be removed from the eye. The various plans which have from time to time been advocated as likely to bring about a restoration of the transparency of the lens, have all, as far as I have been made acquainted with them, led to the disappointment which a moderate acquaintance with anatomy and physiology would probably induce us to anticipate. The instances of spontaneous cure by absorption or dislocation have been too few in number and too slow in accomplishment to have any bearing upon the demands of ordinary practice. What we have to consider is the removal of the cataract, and the removal only.

Admitting this to be so, the first question which we must take into account is the period of development of cataract at which its removal may be safely undertaken; and here we are met by the difficulty of so employing words as to present a

precise picture of the different physical conditions with which we may have to deal. I can remember the time when it was thought inexpedient to extract an opaque lens so long as any layer of transparent tissue intervened between the opacity and the anterior capsule, so long, that is, as the iris, in oblique illumination, would cast a crescentic shadow, no matter how narrow, upon the opacity. The observance of this rule led, indeed, to brilliantly successful results, but it also condemned patients to long periods of waiting which were exceedingly depressing, which meant to the poor the loss of comforts, and, sometimes even to those who were not poor, serious impairment of the general health; and the tendency of my own work, as well as of that of others during the last few years, has been greatly towards operating at a somewhat earlier date. The first step in this direction was probably taken by von Graefe, when he advised that, in cases where one lens was more advanced than the other, and when the first had been successfully extracted as soon as it was mature, the surgeon should "proceed boldly" with the second. Since then, however, great progress has been made. I tried, several years ago, the method of hastening maturation by a needle puncture of the anterior capsule, performed about six weeks after a preliminary iridectomy; but the results of this course were not sufficiently encouraging to induce me to continue it; and I have no experience of the effect of the more recent practice of hastening maturation by something which may be called massage. I find that, after a preliminary iridectomy, made sufficiently long before the final operation to allow the cut edges of the iris to be completely healed, it is possible to extract with safety almost any lens which is sufficiently opaque to involve practical loss of vision; and that, while it is not always possible completely to clear away the cortex in such cases, yet that the resulting iritis, if any should occur, is usually quite controllable, so that perfectly good ultimate results may in this way be attained. I am disposed to think that the disastrous effects of the iritis which so often follow the extraction of an immature lens were mainly due to the fact that, until quite recently, no sufficient

care was taken to exclude septic influence; and that it was the character, rather than the fact, of the inflammation to which it was indebted for its too common consequence. To this part of the question it will be necessary for me to return.

I was for many years accustomed to perform the extraction of cataract under profound anæsthesia from chloroform or ether, and during this time I had no sympathy with those who advocated the abandonment of these agents. No doubt their use was sometimes attended by hurtful consequences, as when the return of consciousness was followed by severe vomiting, or when, in the course of recovery, reflex spasm of the external muscles was produced prior to the completion of the dressing. Notwithstanding this, I am convinced that the balance of advantage was definitely in their favor, and that the accidents which occurred under their employment were largely due to imperfect administration. All this, however, since the introduction of cocaine, has been relegated to the domain of ancient history; for I presume that cocaine is now used by every operator, and that the only question to be discussed with regard to it has reference to the best method of application. I have used solutions of various strengths, and wafers, and have finally settled down upon the latter. The wafers which I find best are those prepared by Messrs. Savory and Moore, which contain a fiftieth of a grain of the alkaloid in each, and which are made with gelatine and glycerine, combined in such just proportions as neither to be sticky in damp weather nor brittle in hot weather. Cocaine has the single disadvantage of causing dilatation of the pupil, by which the iris may be brought somewhat into the way of the knife; and I barely counteract this influence by the use of a single wafer of eserine. The nurse is directed to apply the eserine wafer, in the lower conjunctival sac, an hour before the time of operation. Half an hour later, she applies a cocaine wafer in the same position, and then, after the lapse of ten minutes, by which time general superficial anæsthesia is obtained, she applies a cocaine wafer every five minutes, lifting the upper lid while the patient looks down, and placing each successive wafer upon the region of

the incision, just above the margin of the cornea. By the time that five wafers have been thus applied, and by the time that the instruments have been placed in readiness, the operation will always be comparatively painless, and often absolutely so. It is generally prudent to tell the patient of the moment of puncture, and also of the moment when the iris is to be cut, because, if not warned, and if he felt anything, he might suddenly start, or make some other embarrassing movement.

We arrive now at the consideration of antiseptics, the employment of which is calculated, I feel sure, to remove from the operation many conditions which were frequent sources of failure in former times. My experience leads me to the conviction that the asepticism which is useful and necessary in eye operations may be adequately expressed by the one word cleanliness, and that the septic inflammations of an earlier period were mainly due to the introduction into the anterior chamber of albuminous matter in a state of change, often, no doubt, by means of dirty instruments. Of atmospheric air and its contained microbes, even of the air of the operating theatre of a hospital, I have absolutely no fear; for I have seen, not once or twice, but times without number under general anæsthetics, and with greater proportionate frequency under the complete abolition of reflex muscular action which we obtain from cocaine, the entrance of a large or small bubble of air into the anterior chamber. Sometimes the bubble can be quickly coaxed out again, sometimes it is obstinately adherent to its new quarters, but I have never seen any harm follow from its entrance, whether it was removed or left behind; and now, if it does not escape quite easily, I take no heed of it. The sources of septic inoculation which I chiefly fear are the notch between the teeth of the iris forceps, and the shoulder of the cystotome, both of them places in which the material remnants of former operations are likely to remain. When this idea first occurred to me, I made it a practice to examine these portions of the instruments in question, when they were supposed to be clean, with a sufficiently powerful lens, and I have in this way seen enough dried blood, or

dried lens cortex, adhering to them to explain the prompt destruction of any eye into which they were introduced. My present practice, after returning from an operation, is to wash these instruments with hot soap and water and a soft badger's hair tooth brush, and to examine them with a magnifier before they are put away. Then, immediately prior to an operation they are dipped into absolute alcohol, and dried upon a piece of suitable soft tissue. The knives, scissors, and other instruments which offer no similar coigns of vantage for the lodgment of dirt, after a preliminary cleansing in the ordinary way, are also dipped into absolute alcohol before being used.

Not less important than the instruments are the sponges. No other absorbent material will adequately replace a small piece of soft sponge as a means of quickly removing blood or fluid or soft cortex from the conjunctival surface or from the vicinity of the wound; but the absolute cleanliness of what is thus employed is a matter of the first necessity. After a thorough preliminary washing in cold or lukewarm water, in order to remove all traces of blood without coagulating its albumen, my sponges are prepared by soaking them for a few minutes in a mixture of Condy's fluid and water, which must not be too strong, as the permanganate rots the sponge tissue, and this effect, which is valuable as a source of softness if not carried too far, might easily proceed to complete disintegration. After being rinsed in clean water to free them from the Condy, they are next thrown into a mixture of equal parts of the sulphurous acid of the *Pharmacopœia* and water, and they remain in this for a few minutes until they are completely bleached. They then receive a final rinse in water, and are ready for use. They must, of course, be moist at the time of operation, and they may be moistened either with water or with the antiseptic solution of which I have next to speak.

During the last year or two, especially in Paris, much use has been made of real or supposed mercurial antiseptics in the extraction of cataract. I say real or supposed, because one of these preparations—the formula for which was published in a medical journal—was said to be an aqueous solution of binio-

dide of mercury. As biniodide of mercury, in my younger days, was insoluble in water, I had the curiosity to have the liquid made according to the directions given, and then tested for mercury, of which it was found to contain none. This was probably an advantage, because mercurial solutions, unless so weak as to have no promise of any kind of potency, are active irritants; and I have quite convinced myself that the amount of swelling which sometimes follows Dr. Mules's operation for the insertion of an artificial vitreous is largely attributable to the use of mercuric perchloride as an antiseptic. Carbolic acid will often greatly disturb and irritate the corneal epithelium; and, after many trials of various preparations, I have come to the conclusion that the boroglyceride, first suggested by Professor Barff, is at once the least irritating and the most efficacious. I use it in a solution of 15 per cent. in distilled water.

As the eye, in cataract extraction, is scarcely at all touched by the fingers of the surgeon, and as I have already stated that I have no fear of the entrance of air, it follows that the only septic influence to be removed must be sought in the secretions of the conjunctiva and lachrymal passages, and, above all, in the gelatine of the dissolved cocaine wafers. Especially on account of the latter I should fear to introduce into the anterior chamber even a knife which had come into contact with the uncleansed surface of the eyeball. My first step is to wash the whole of the conjunctiva carefully with the solution of boroglyceride, which is suffered to fall upon the eye from a pipette, and is distributed over the surface by closure and gentle friction of the lids. This washing is twice or thrice repeated, until I am sure that all gelatine is cleared away or disinfected; and then the margins and surfaces of the lids are themselves washed with the same solution applied by a morsel of sponge. If a cocaine solution has been employed, and if this is saturated, as it should be, with salicylic acid, the washing of the conjunctival sac is unnecessary; but the action of the wafers is, I think, more trustworthy, and the complete removal of their gelatine should never be omitted.

The surface of the conjunctiva having been thus prepared, the next step is the elevation of the lid. For this purpose I have abandoned the use of the spring speculum from the time of the introduction of cocaine, and use a slight modification of Dr. Noyes's well known retractor. In the original instrument the groove is straight, and, as the eyelid is curved and somewhat stiff, it is uncomfortable within the groove, and is sometimes released by involuntary muscular effort. I have had the groove curved, and with this alteration the lid lies in it without movement. I commit the handle of the retractor to a nurse or assistant, who stands on my right, using the left hand for the right eye. The hand holding the retractor passes between mine, and does not in the least interfere with their freedom of movement. My instruction to the assistant thus employed is simply to lock up the eyelid under the brow without exerting any pressure upon, or even without permitting any contact with, the eyeball, and the lid can be released in a moment whenever occasion to do so may arise. I then draw down the lower lid with one finger, and fix the eye by pinching up a vertical fold of conjunctiva and subconjunctival tissue, exactly on the vertical meridian, and as near to the lower margin of the cornea as will afford sufficient subconjunctival tissue to the grasp of the forceps. My fixation forceps have interlocking teeth, three on one blade and four on the other, and they present on the eyeball, when these teeth are closed, a smooth round, flat surface, at least two millimètres in diameter.

Mr. Critchett has lately recommenced a method of elevating the upper lid by the ring finger of the operator, while the fixation is accomplished by forceps held between the thumb and index finger of the same hand. With great respect for him, and with due regard to what I have already said about the personal element in all such questions, I think his method is mechanically inferior to that which I have described, and that is is, therefore, of less general applicability. By it the freedom of movement of the fixing hand, and the freedom of choice of the point of fixation, are both, to some extent, di-

minished. The operator who thus elevates the lid would find it impossible, I conjecture, to fix below the cornea exactly in the vertical meridian, and to this I attach importance, because it is only in this way that the line of section can be made to lie precisely parallel to the horizontal meridian. Unless this object is secured any astigmatism which may follow the operation is almost certain to have oblique chief meridians, by which the difficulty of obtaining perfect correction by lenses is increased, while in the few cases in which, if an adequate amount of subconjunctival tissue is picked up, the conjunctiva nevertheless tears, and a fresh and different hold has to be taken, the operator whose hand was also employed in elevating the lid would, I imagine, find himself placed at a decided disadvantage.

In the method of fixation which I have described, the margin of the lower lids is held down, and kept out of the way by the forceps themselves.

It has been said that any text in the Bible will serve the turn of a preacher who has something to preach about; and, in the same way, almost any cutting implement would allow a skilful surgeon to divide the tunics of the eye in such a manner as to give exit to the lens. Nevertheless, the form of the knife deserves consideration, and my own requirements are best fulfilled when it is as small as it can be made. My friend Dr. Randall, of Philadelphia, has lately written in such eulogistic terms of the concave knife which was contrived by Jaeger some years ago, that I have been induced to try it, with the result that I have gone into the very opposite extreme; and, instead of merely feeling a fondness for old knives of Lienhardt's pattern which have been reduced in size by grinding, I have requested Messrs. Weiss to make the smallest blades possible. The object of Jaeger's knife is that it should make a certain definite incision, by virtue of its own peculiarities, when it is pushed straight on in a mechanical way by the operator; and the object of mine is that it should require the volitional direction of the operation from the beginning to the end of its course, and its small bulk should allow its edges to

be turned forward as much as may be required, without any pressure being exerted upon the iris, or through the iris upon the periphery of the lens, by its back.

The fault of these very small blades is that they are prone to permit escape of the aqueous humor, especially in the hands of an operator who is very deliberate in introducing them, and that in this way the iris may fall over the edge. It is necessary, as soon as the point appears within the anterior chamber, to carry it across and to accomplish the counter-puncture quickly; at the same time pressing the back of the blade against the corneal tissue, so that the opening may not be enlarged by the cutting edge. A further security may be obtained by oiling the blade, a plan which I now adopt with every form of knife which I introduce into the eye, and by which not only is resistance much diminished, but the course of the blade, in cutler's phraseology, is materially "sweetened." I use a mixture of equal parts of castor and olive oil, to which five per cent. of eucalyptus oil is added, a mixture much in favor at St. George's Hospital as a general surgical lubricant. A drop of this oil may be placed on the tip of a finger, and the knife drawn through it immediately prior to the introduction. When once the counter-puncture is made, and the iris is sufficiently held back by the knife to be in no danger of falling forward or of being injured, the edge of the knife may be turned forward to any required extent in the wound, so that its direction between the punctures is absolutely at the command of the operator, and the section may be placed exactly as he may desire. The best position for it, I think, speaking generally—the position which affords the easiest exit to the lens—is that in which the puncture and counter-puncture are barely in front of the iris, and in which the centre of the incision is just behind the junction between the visible cornea and the conjunctiva, the knife carried a little backwards, after the more resisting structures are divided, so as to form a conjunctival flap. The profile of such a section bends forward in a slight curve; and, with the narrow knife of which I have spoken, the character and amount of the

curve may be determined as the operator may desire. With regard to the length of the incision, I fear I am unable to speak in millimètres, and must confess that I follow a sort of rule of thumb. I make my incision longer or shorter, according to my estimate of the bulk of the nucleus of the lens. I strive always to keep its base line parallel to a tangent with the upper corneal margin, but place this base line a little higher or lower as I wish the total length to be more or less.

I much regret that I have had no opportunity of witnessing what I hope we shall hear fully described in the course of the coming discussion, namely, the section made by Mr. Teale, and which, as I understand the description of it, is brought almost directly forward through the upper part of the cornea, and provides, by its shape and direction, for the perfect apposition of the cut surfaces. I am not in a position to speak of its merits; but I am bound to say that I have regarded all previous forms of section through the true cornea with great disfavor. I think they are all of them apt to produce, in the contraction incidental to healing, some distortion of the corneal surface which renders it no longer a surface of revolution, and which is therefore liable to entail a defect of vision which lenses are unable to correct. This applies very strongly, as I have often witnessed, not only to the proposal of Dr. Küchler to divide the cornea on its horizontal meridian, but also to the sections above or below the horizontal meridian, which were at one time advocated by Dr. Liebreich and by Mr. Bader.

We now approach the question which, more than any other, has been discussed of late years—the question of iridectomy as part of the operation of extraction; and, at the outset, I must express myself as being decidedly in favor of it. In order to state reasons, it is expedient to go back and to glance at the history of the matter. Iridectomy was first practiced by Mooren, as a preliminary measure to flap extraction, and it at once enormously reduced the percentage of his losses. Its beneficial operation was explained by him and by von Graefe, on the twofold ground that, by removal of the portion of iris which was otherwise most liable to be compressed and bruised

in the exit of the lens, it took away one active cause of subsequent iritis, and that, by facilitating the exit of the lens, and thus permitting the length of the corneal wound to be diminished, it diminished in a corresponding degree the risks of necrosis of the cornea. Operators whose experience goes back for only fifteen or twenty years can hardly realize that, thirty to thirty-five years ago, 15 per cent. of all the eyes operated upon were totally lost by general suppuration, which usually commenced on the second day as iritis, or by sloughing of the cornea. No doubt the iritis, although then commonly attributed to bruising, was frequently septic, and would not nowadays be permitted to occur; but we do see iritis in spite of all precautions, and I feel sure that iritis occurring after extraction in an eye which has been iridectomized may generally be regarded as a comparatively harmless complication, while iritis occurring in the same conditions in an eye which has not been iridectomized is a very threatening one. No one who has had experience of both methods can doubt that the iridectomy removes what must otherwise be an impediment, in a greater or less degree, to the exit of the lens, or that it fulfils the condition to which von Graefe attached so much importance, that of preventing the iris tissue from being bruised, or its circular fibres from being injured by rapid and forcible dilatation. Nor can there be any doubt that it greatly facilitates the complete removal of cortex, not only by direct pressure, but also by the introduction of a curette, which could not, of course, be carried into the space lying behind the uncut iris in the proximity of the wound. Another point which I would urge in favor of iridectomy is that it minimizes the ill-consequences of loss of vitreous. When vitreous escapes from an iridectomized eye, any further small amount which may be lost after the application of the dressings does not add in an appreciable degree to the attendant risks; but if the iris be entire, the immediate effect of the loss is to lift the iris into the section, and thus to produce, even in favorable cases, entanglement, delayed healing, and distortion of the corneal curvature. Against these advantages, what is there to be said on the other side? I am,

perhaps, hardly a competent judge, for I was, I believe, the first surgeon in England to perform iridectomy as preliminary to extraction. This was in 1862, soon after Mooren sent me his pamphlet on the subject. I have never since performed extraction without iridectomy, either as a preliminary measure or as part of the operation, and I have never seen a single case in which I could say, if this eye had not been iridectomized, the result would have been better than it is. In my first cases, twenty-five years ago, I selected patients upon whom I had previously performed flap-extraction on the other eye with good results, and I satisfied myself that, in these persons, the vision of the second eye, which was iridectomized, was as good as that of the first, which was not. In eyes which, apart from cataract, are healthy, I very often obtain normal vision, and I therefore fail to see why the iridectomy should not be performed in every instance. In fact, I think that those who object to iridectomy surrender their whole case when they say, as they generally do, that they would reserve the procedure for cases in which there was some unusual risk. They confess by this that iridectomy increases safety, or, as I should prefer to put it, that it increases the percentage of success; and, if so, why should any patient be deprived of this advantage? I am quite certain that I have seen iridectomized eyes recover from accidents and complications which, but for the iridectomy, would, I believe, have been fatal to them; and such accidents or complications cannot always be foreseen. I would cite as an example an accidental blow, three or four days after the operation, which produced considerable intraocular hæmorrhage. That was five years ago, and the recovery was protracted, but the patient has now normal vision. I fully admit that admirable results may be obtained without iridectomy; but I take my stand upon the position that the surgeon might frequently have occasion to regret having omitted iridectomy, while I believe that he will never have occasion to regret having performed it. In the cases of a special kind, in which it is generally advocated even by those surgeons who have abandoned it in normal conditions, in cases of diabetic cataract, in

very marasmic subjects, and the like, my own practice is still to make a rather large iridectomy as a preliminary measure, so as to obtain firm healing of the cut edges of the iris before they are exposed to the possibilities of irritation from residual cortex, whereas, in otherwise healthy eyes, I make my iridectomy smaller, and make it as a part of the general operation.

The iridectomy having been accomplished in the ordinary way, the next steps have reference to the capsule. In a very aged patient I always make a large iridectomy, followed by a gentle endeavor to coax out the lens in its unbroken capsule, and when this succeeds the result is usually extremely satisfactory. Except in the very aged, such an endeavor would be attended by risk of rupturing the hyaloid, and whenever the attempt is either not made or is abandoned, I divide the capsule as freely as possible, first vertically, beginning at a point well below the lower margin of the pupil, and then peripherally. In pressing out the lens I aim at the definite object of causing it to turn upon its horizontal axis, so as to present its upper edge to the section, and for this purpose make my pressure, in the first instance, directly backward over the lower portion of the cornea, using sometimes the back of the silver curette, sometimes that of the shell spoon, and following the lens up the cornea as it advances, until its diameter is fairly outside the edges of the wound, when the pressure may be relaxed, and the exit left to be completed by the resiliency of the tissues.

Mr. Tweedy has lately advocated a simple peripheral division of the capsule in cases of immature cataract, with the idea that the lower part of the capsule is thus left as a sort of pocket, which retains residual cortex until it is dissolved, without permitting it to be at large in the anterior chamber, and a source of general irritation to the eye. I am afraid that this pocket will be found difficult to empty, that it will sometimes retain a good deal more than is desirable, and that its contents may often become sources of prolonged trouble. Even in immature cataracts I much prefer a thorough division of the cap-

sule, and a sedulous endeavor to coax out as much as possible from the eye. Under cocaine this may be done without risk of exciting reflex spasm of the recti, and consequent loss of vitreous; and by the devotion of sufficient time may always, I think, be so effectually accomplished that any small portion which is necessarily left behind is not likely to occasion more than temporary difficulty. In immature cataracts, however, it must be remembered that the vision test cannot be relied upon as a proof of the complete removal of cortex. When this is still transparent it may, even when present in considerable quantity, permit the patient to recognize the different fingers of the surgeon, and the appearance of the pupil under focal illumination furnishes indications which are much more trustworthy. After the fingers can be recognized, continued careful and dexterous manipulation will often expel quite a considerable quantity of viscous cortex. The manipulation required is not only very difficult to describe, but is too familiar to such an audience as this to require description. It consists of gentle upward stroking of the corneal surface with the back of the customary shell spoon, alternating with careful rotatory friction through the closed lids, and the cortex may often be assisted to escape by separating the edges of the wound with a curette, or by pressing back the posterior edge with Pagenstecher's spoon. I may, perhaps, be permitted to say that the perfect manipulation of the eye for the expulsion of the bulk of the lens, and afterward for the expulsion of residual cortex, appears to me to be quite the last attainment of the finished operator, and to be of infinitely greater difficulty and importance than any of the steps previously described, and by which it must of necessity be preceded.

With reference to clearing the capsule, we have to consider the question of "washing out," whether this be done, as by Dr. McKeown, for the purpose of completely removing the cortex, or, as more recently by other operators, for the purpose of introducing an antiseptic. The idea of washing out must, I think, have occurred to many people. I practiced it myself on one occasion, before the appearance of Dr. Mc-

Keown's paper. I was removing by suction, from the eye of a young lady, a lens which had been rendered opaque by an accidental blow, without any wound of the external tunics of the eye, and was removing it merely to restore the blackness of the pupil. Certain fragments did not fall readily into the suction tube, and I gently injected the lenticular space with water, using for the purpose an ordinary hypodermic syringe fitted with a blunt nozzle instead of a needle. The proceeding was effectual; but, whether in consequence of it I cannot say, the eye passed into a state of chronic inflammation and ultimate wasting. After the appearance of Dr. McKeown's paper I obtained his syringe and used it in one or two cases, but I did not obtain from the practice any advantage which encouraged me to persevere. I have not used it for a considerable time, and, as far as I can foresee, am not likely to use it again.

Of the method employed by some operators, of washing out the capsule and the aqueous chamber with an antiseptic solution, I have at present no experience, and do not think it likely that I shall acquire any. I do not see that such a proceeding is likely to be attended with any good results which may not equally well be obtained without it; and it is certainly a complication which must entail additional risks in some directions, as, for example, of loss of vitreous. From descriptions which I have read, the injection of an antiseptic appears frequently to be followed by severe and long continued pain; and I should regard this fact alone as sufficient to condemn it. Pain should, I think, as far as possible, be banished from surgery; and it is certainly, more especially in old and feeble people, like the majority of cataract patients, highly detrimental to repair. I have also read of the use of a squirt for the purpose of displacing iris from the angles of the wound; but such displacement, when it is called for, seems to me to require only the careful manipulation of a whalebone spatula.

We come now to the question of dressing, on which we have lately been invited to return, as to a novelty, to the method which was universal thirty years ago, or, indeed, until von

Graefe introduced his pressure bandage, and which had then held uninterrupted possession of the field for a century. We are invited to fasten the lids together with bits of sticking plaster, and to abstain from the use of a compress. I find it difficult to criticise the proposal in any words more fitting than those which were applied, to a very different subject, by Lord Macaulay: "We are sick, it seems, like the children of Israel, of the objects of our old and legitimate worship. We pine for a new idolatry. All that is costly and all that is ornamental in our intellectual treasures must be delivered up and cast into the furnace—and there comes out this Calf!" If there be any established fact in surgery, I think it is that gentle uniform support promotes the healing of a wound; and I had too much experience of plaster, thirty years ago, to have any inclination to return to so primitive a material. After carefully removing all shreds of coagula from the conjunctival sac, after liberating the iris, if entangled, from the extremities of the wound, and after obtaining the best possible apposition of the wound edges by means of a spatula, I permit a few final drops of the boroglyceride solution to fall upon the eyes from a pipette, and then place over the closed lids of both eyes, whether or not only one has been operated upon, a piece of old pockethandkerchief, about an inch and a half square, smeared with Sanitas vaseline. I then take a portion of common non-absorbent cotton-wool, soak it in water, mould it into a shape like that of a meniscus lens, press out superfluous moisture, and place it in such a way that its concavity receives the projection of the eyeball. Both eyes being thus covered, I place horizontally over the wool pads the bandage which was, I believe, introduced by Dr. Liebreich, and which consists of a strip of knitted cotton; but I have three pairs of tape strings attached to it, one pair in continuation of its length, the other two pairs at right angles to the former. The horizontal pair being first tied with a proper degree of tightness, one of the other pairs is tied over the top of the head, the other under the chin. This bandage never slips nor becomes displaced, and the degree of pressure which it exerts may be

exactly regulated in accordance with the comfort of the patient. I usually renew the dressing twice a day, but without opening either eye, until forty-eight hours have elapsed; and the effect of the Sanitas vaseline is that the pads are never rendered adherent to the eyelids or eyelashes by secretion. When it is necessary to remove them, they drop off at a touch.

After forty-eight hours, I open the eye operated on, when, if all be well, I feel justified in assuring the patient that the ultimate result is secure, and I release the eye which has not been operated upon. The bandage is then placed obliquely, and it retains its position as well as before. After this time, the vaseline is no longer required, and the pad is only wetted. After the lapse of a week, the pad itself may usually be discontinued, and the eye protected only by a shade.

If any cortical matter has been left within the eye, I commence about the fourth or fifth day the instillation of atropine; using it in weak solution, say, of half a grain to the ounce, and combining with it two grains of cocaine. This may be continued, without fear of surface irritation, until all soluble matters are absorbed.

In a considerable proportion of instances it will be found, when vision is accurately tested in about six weeks after the operation, that it is diminished by the presence of delicate films in the pupil. When the iris is perfectly free and movable, and when the films are only shreds of the anterior capsule, or are formed by the unbroken posterior capsule, I think the best practice is to divide them with two needles, after the manner first contrived and recommended by Sir William Bowman. The needles for this purpose should be new and carefully selected, so that their points make a sufficient opening to allow free play to their shafts; and, if they are oiled in the manner already described when speaking of the knife, there will be scarcely any escape of aqueous humor, even when they are withdrawn. If pupillary obstructions are more dense, if they are the results of iritis subsequent to the operation, and especially if the lower margin of the pupils be at all drawn up toward the wound, I am no longer satisfied with needles, but

prefer to divide the films; and, in the case last mentioned, the iris tissue also by the capsule scissors. For this purpose I use scissors of the pattern which I designed some time ago. I make the necessary small incision in the centre of the cicatrix of the extraction wound and divide the films, and, when necessary, the iris, in a direction vertically downward. By this proceeding all dragging is at once relieved. I have heard of such operations being followed by disastrous consequences, but I have never seen an example; and, on the whole, I think that an eye in which capsule has been divided, so that free communication exists between the aqueous and vitreous chambers, is left in a better position than one in which this procedure has not been required. It is quite conceivable that a pectous condition of the lens capsule, by which the transudation of nutritive fluid is diminished, may be at least one among the causes of cataract, and such a condition, after extraction of the lens, might in the same way promote increase of tension. If an eye from which the lens had been removed were threatened with glaucoma, the first thing to do would be to make a free opening in the posterior capsule, and I never regret having to do this as part of the original operation. * * * —*Brit. Med. Jour.*

CORRESPONDENCE.

LOUISVILLE, KY., Jan. 11, 1889.

DR. ADOLF ALT, St. Louis, Mo.:

MY DEAR DOCTOR.—I have just read an eulogy of Dr. Elkannah Williams, in the November number of the JOURNAL OF OPHTHALMOLOGY. Unwilling to draw a single ray from the lustre of his renown, I am, nevertheless, impelled by a sense of the importance of the truth of history, to correct two very striking errors; in 1876 he was not Chairman of the Section on Ophthalmology in the International Medical Congress; he did not receive the degree of M. D. from "the Medical College of Louisville, Ky." The Chairman of the Section of Ophthalmology in the International Medical Congress of 1876 was Robert Brudenell Carter of London. The Vice Presidents were Wm. Thompson, of Philadelphia, and Henry W. Williams, of Boston. Dr. Elkannah Williams graduated at the University of Louisville, which has never been known by the title of the "Louisville Medical College," nor "the Medical College of Louisville." There were two medical colleges here at that time; one the Kentucky School of Medicine, the other the Medical Department of the University of Louisville. In the latter institution Dr. Elkannah Williams graduated in March, 1850. In a biographical sketch written by Dr. Williams himself (Biographical Dictionary of American Physicians and Surgeons, edited by Wm. B. Atkinson, Philadelphia, 1880, second edition), it may be seen that he practiced in Indiana for the next two years ensuing the date of his graduation. "In the spring of 1852 he settled in Cincinnati to engage in the regular practice of medicine. In November of that year he sailed for Europe, for the purpose of studying Ophthalmology. In the spring of 1855 he returned to Cincinnati and com-

menced the practice of Ophthalmology and Otology." Dr. Williams of Cincinnati, though a frequent contributor to the periodical literature of the day, did not leave any permanent work; on the other hand, Dr. Henry W. Williams, of Boston, is the author of several books, the most important of which is a Systematic Treatise on Diseases of the Eye. It has long been claimed that Dr. Henry W. Williams, of Boston, was the first regularly educated specialist in ophthalmology in the ranks of the medical profession in America. Dr. Williams, of Cincinnati, was elected President of the Ophthalmological Congress which met in New York, in 1876, and which was a distinctive organization of specialists. Out of the score of more or biographical sketches written since the death of Dr. Williams, none of them have been free from error. The claim of his having introduced the ophthalmoscope to the surgeons of the Royal London Ophthalmic Hospital is not true. Fresh from Berlin, he entered the London Institution with the newest form of instrument in his pocket, and delighted the staff with his superior skill in its use. I am, dear doctor, with great respect,

Your obedient servant,

DUDLEY S. REYNOLDS.

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23 MERRION SQUARE, DUBLIN, JAN. 13, 1889.

MY DEAR DOCTOR.—May I ask you in your next issue to correct an inaccuracy which occurs in reference to the symptom of dyslexia in my paper which appeared in your December number. I make the statement that "in every instance the lesion was on the left side of the brain." It should be in all the cases except in Brun's case the lesion was on the left side of the brain. In his case there was atheromatous degeneration of most of the large arteries of the brain and softening of the *right* external capsule and lenticular nucleus, while the left side of the brain was normal. The examination of the brain here was wholly macroscopical, but so far as it goes it tends to lessen the value of dyslexia as a localizing symptom.

I am yours very faithfully,

H. R. SWANZY.